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The marsh and lake region
at the head Chignecto Bay

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The marsh and lake region
at the head

Chignecto ^{of} Bay

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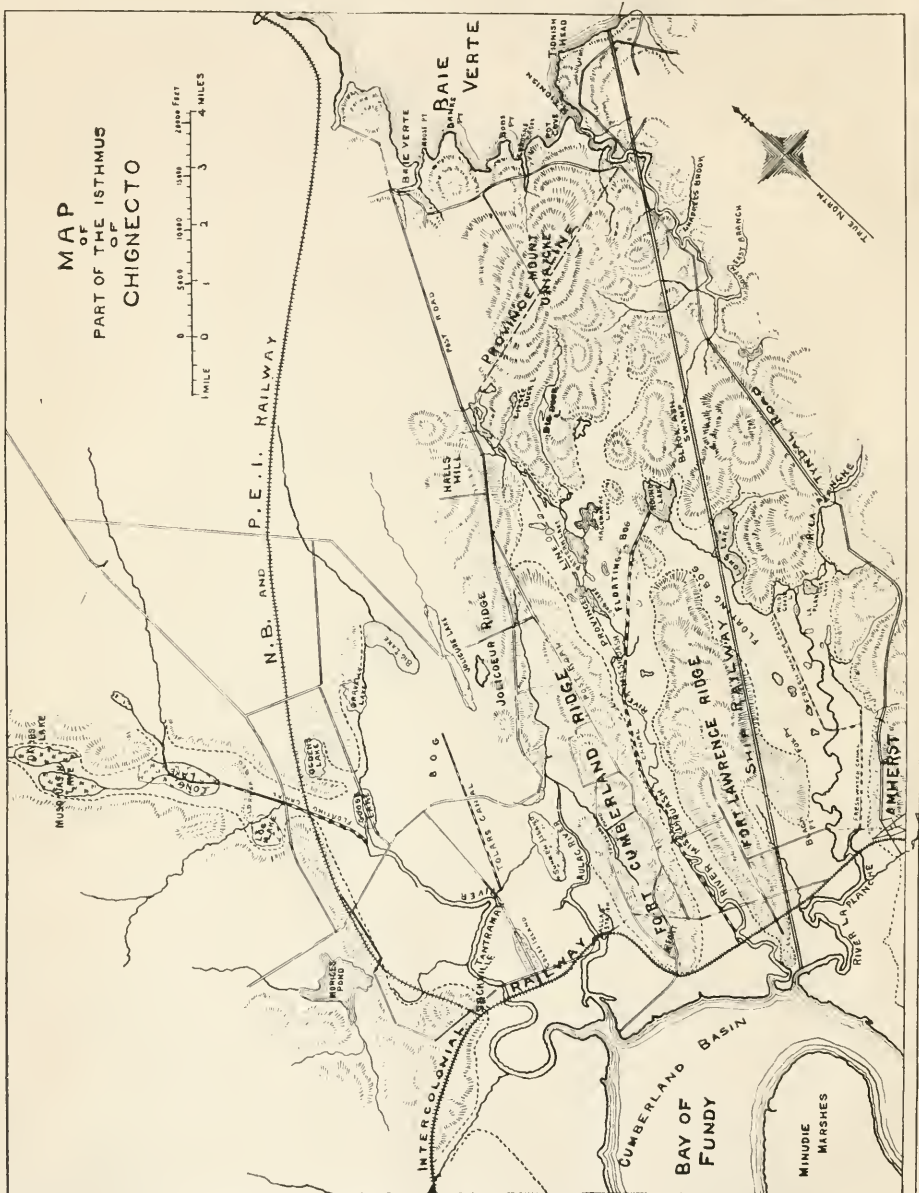
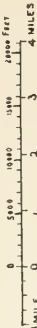
George Johnstone Trueman





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THE MARSH AND LAKE REGION AT THE HEAD OF
CHIGNECTO BAY.

BY GEORGE J. TRUEMAN, M.A.

Read April 2, 1896.

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Geographical Description.—The Isthmus of Chignecto is about fifteen miles wide at its narrowest part. Its western shore is washed by the head waters of the Bay of Fundy. This Bay, running up toward the north-east, tapers into Chignecto Bay, which divides into Shepody Bay on the north and into Cumberland Basin, between Cumberland in Nova Scotia and Westmorland in New Brunswick. These two arms of Chignecto Bay are separated by a somewhat boot-shaped piece of land, known as the Meranguin Peninsula.

Shepody Bay receives the waters of the Petitcodiac and Memramcook, while the Tantramar, Aulac, Missiguash, La Planche and River Hebert, with the Nappan and Maccan Rivers, flow into Cumberland Basin.

All these streams have areas of marsh or bog lands along the greater part of their courses. The largest bodies now in cultivation are along the Tantramar, the most northerly of the group. The relative position of the rivers can be best seen from the accompanying map, but a few words of description are necessary for those who are not familiar with the country.

The Tantramar and Aulac flow into the Basin by one mouth. Some three miles up the Tantramar is the village of Sackville. The river, with its numerous windings is about twenty miles long. Some eight miles from the mouth the stream divides, one branch coming from Cookville on the north, and the other flowing down the marsh from the north-east.

The Aulac is not separated from the Tantramar by a ridge of highland, as is usually the case with the marsh rivers. About five miles from the mouth, the Aulac branches, one branch, La Coup, flowing down from the Jolicure Lakes to the north of Jolicure, the other branch coming down between Jolicure Point and the Aulac ridge.

The Missiguash River flows almost parallel with the Aulac, from which it is separated by a high ridge of millstone grit, called the Aulac or Point de Bute Ridge. This river is not more than twelve miles long, and the upper part of its course is lost in a maze of lakes and bog. Along its lower course it forms the boundary between the two provinces, New Brunswick and Nova Scotia.

At the same mouth by which the Missiguash enters the Basin, the La Planche finds its way to the sea. The lower courses of the rivers are separated by Fort Lawrence Ridge. This ridge is not so high as that on the north of the Missiguash, and it is overlaid with Permo-Carboniferous rocks. The lakes and bogs of these two streams unite at their sources. The town of Amherst is south-east of the mouth of the La Planche, beyond this the Basin takes a sudden turn to the south, and terminates in the mouth of the River Hebert.

Surface Geology.—The Isthmus is overlaid with Permo-Carboniferous rocks, with the exception of the Aulac Ridge with its continuation across the mouth of the Aulac and the Tantramar to Westcock. This strip is Millstone Grit.

The marsh mud is from one to one hundred and fifty feet deep, and is underlaid with Permo-Carboniferous shales and sandstones. These shales are covered in many places with heavy red clay similar to that found on the Aulac and Fort Lawrence ridges. The marsh

mud and underlying soil are perfectly distinct, and there is every evidence that the mud has been laid down in recent geological times ; certainly since the Glacial period. Off Fowler's Hill, on the Aulac Ridge, the descent is very rapid, and one-third of a mile from the shore borings have shown the mud to be one hundred and fifty feet thick. At the same distance from the Sackville shore, where the hills slope more gradually, there is not more than sixty feet of mud.

Formation of the Marsh.—As to how this marsh was formed one not thoroughly conversant with the geology of the region can do little else than speculate. There have evidently been many changes in the level of the southern shore of New Brunswick in known geological times. Dr. G. F. Matthew considers that the Isthmus was far above its present level in the Glacial period. At that time Chignecto Bay would be a valley and the Bay of Fundy dry land. Glacial action would have eroded the surface and moved the loose incoherent material to lower levels. The depression of the land that followed the glacial period would have allowed the accumulation of marine clays such as are now found on the Aulac Ridge and adjoining elevations. A subsequent re-elevation would permit the accumulation of forest mould and soil on these ridges and the contiguous valleys.

In 1892, when excavations for the marine dock were being made near the mouth of the Missiguash River, numerous trunks of trees were found about at low tide level. Sir Wm. Dawson, some years ago, found a stump there showing over one hundred rings of growth. (Acadian Geol. p. 28-29). Some of these trees were white pine, others beech ; neither variety attain such a size on damp land. Evidently the land where these trees were growing was much above its present level. The trees were found rooted in a rich loamy soil resting on a bed of red clay. To be above the reach of high tides the region would have to be from sixty to eighty feet above the present level.

On the Baie Verte side of the Isthmus abundant evidence is found of recent depression. Mr. E. P. Goodwin, C. E., of Baie Verte, while digging mud for fertilizing purposes, found oak leaves and spruce cones in the solid mud twelve feet below the surface, and there was every evidence that they had fallen on what was then the ground surface.

The subsidence was probably gradual, and on the Bay of Fundy has practically ceased, as the dykes have not been made perceptibly higher in the last 100 years.

When the regions first settled below high tide level, the salt water would creep around the sturdy beeches and pines, and while depositing the food for plants yet to grow, would kill off the old and hardy race of trees. Ice would break off the tops of these trees, and the water bear them away, or the elements would rot the tops down, and only the lower part, encased in the solid mud, would remain to tell the story of the old upland valleys now under the marsh. The land nearest the Basin would at first be submerged, but as the depression went on the salt water would make its way further and further up the valleys. It would seem from an examination of these regions that neither moss nor grass made any perceptible growth until the subsidence ceased. At points down the Bay there is evidence of different surface soils of the marsh that were formed in the process of settlement. On Cobequid Bay near Onslow several turfs are plainly seen, each separated by a foot or more of deposited mud. A canal, fifteen feet deep at the mouth with a grade of two feet to the mile, is now being dug up the Point de Bute marsh, and in no place throughout the three miles already dug is there any evidence of vegetable remains below the present surface. In the marsh soil vegetable remains would be very readily detected by the presence of the surrounding blue mud. The same absence of blue turf or peaty surfaces is seen wherever canals have been dug in the marsh soil.

The marsh rivers are constantly changing their beds. After the depression first occurred they may have kept their channels for some time, but by the rush of mud-laden water every curve becomes greater; as the stream rushes against the opposite bank one side wears off and the other builds on.

In the memory of men now living, marked changes have been made in the position and direction of some of the rivers. Off Prospect Farm at Point de Bute, the Aulac has, in the last two hundred years moved some three hundred feet nearer to Sunken Island. This change is clearly proven by the old dykes. When it is remembered that the Aulac has been abandoned for sixty years, it will be seen how rapidly these changes are made.

Marsh Improvements—Nature did much to make this a fertile region, but it was necessary for man to make some exertion that he might reap the harvest. The French, settling here in the seventeenth century, dyked the rivers and raised crops on the marshes. There are records of their damming up the smaller streams in the first half of

the eighteenth century. Father LaLoutre used the men and money for this purpose that were sent him to be used in putting Fort Beausejour in a state of defense, but not until the English came to this country were large aboideaus built.

In 1827 the Aulac was aboideaued four miles from its mouth, and in 1840 an aboideau was thrown across less than two miles further down.

Eighty years ago these lands presented a very different appearance from what they do now. The Aulac was much larger, at least in its upper course, than the Tantramar. The bridge across the Tantramar, where the upper bridge now stands, was just eighteen feet wide, as stated in an old contract. Above this point the whole region was covered with moss, and the water oozed rather than flowed into a very crooked, lazy stream. A mile north-east of the bridge, in the bog, Goose Lake was situated. Its waters flowed north-east to Gravelly-beach Lake, and then in about the same course to Big Lake. Big Lake drained into the Aulac through La Coup. A large part of the land in the lower course of the rivers was also bog.

About 1815 Tolar Thompson started a canal between the Tantramar and Goose Lake. This man, a farmer, had made a careful study of the lake region, and was convinced that the lakes could be drained and made into marsh. Before this canal was finished in 1820, one was dug in a northerly direction toward Log Lake. The old river course and the canals can be seen on the accompanying map. The new canal took a straight course. Tolar's Island and the old river bed with its many curves, filled up level with Bay of Fundy mud. This canal was cut through about ten feet of moss, but did not go into the underlying mud. The moss was cut in large junks and floated down the stream by the receding tide, hence the name "Floating Canal" which it still bears.

In recent years, this canal has been extended five miles beyond the Upper Bridge, and hundreds of acres of good marsh are to be seen in the place of lake and moss. The lakes were from four to seven feet deep, and they were allowed to fill with mud before the surrounding moss was covered with the deposit. Several small lakes on this branch are still unreclaimed, but they are gradually filling with the mud from the canal. Blue or red mud underlies all the lake and bog areas, and is found in the valley eight or ten miles above the upper bridge. The greater part of the low moss has been made up, but hundreds of acres of high moss are still growing "hard hacks" and small trees.

The floating canal has greatly increased in size since it was dug and has worn into the mud from two to four feet. On the more southerly branch of the Tantramar, at Goose Lake, hay has been cut for seventy years. Moss is again growing on this lake and surrounding lands, and large tracts are having their fertility ruined. The more energetic farmers are digging wide ditches and using the rich marsh soil thus obtained as a fertilizer. Good results are in this way secured.

The Aulac river has not been so well handled. The Trueman and Etter aboideaus have much reduced the size of the river. The system of lakes at the head of LaCoup stream is shut off from the tide. The rail and carriage roads cross the river on the Etter Aboideau. Only at a great cost could the river be again opened and the natural fertilizers carried to the Point de Bute marshes. Not only this, but some of the lakes on La Coup have been turned down the Tantramar, and even were the stream opened, the basin above into which it might throw its waters would be much reduced.

Formation of Lake and Bog.—One naturally wonders how all these lakes were formed, and what led to the tremendous growth of moss. The building up of the lakes has given a clue to their formation. When the water is first let into a lake the greatest depth of mud is deposited at its mouth, where the tidal waters enter. If the season is rainy the outflowing fresh water may prevent any deposit, but if the time is dry eighteen inches of mud may be laid down at a lake entrance in a single set of spring tides. The reason for this is evident. The water, running up the canal with great force, loses its speed as it spreads over the lake, and the larger part of the sediment settles at once. As the water runs slowly up the river in the neap tides, much sediment is deposited in the river bed. When the spring tides come on, especially those in the late summer when it is usually dry, this sediment is lifted and carried into the lakes above. Thus the water at the head of the stream is often more heavily laden with mud than that further down.

Red or blue mud underlies both lake and bog, its depth varying as the underlying soil rises or falls. Under the whole upper section the mud is about the same level. Owing to the gathering of silt the lake bottoms are often higher than the mud below the surrounding bog. Evidently the tide once flowed through the whole valley without being hampered by lake or bog. Before the marsh reached its present state of depression, lake basins were formed by the water damming itself in

as before explained. These lakes and ponds may have been many times drained by the water breaking out in a weaker place. The same thing now takes place in draining the lakes. After the tide has entered, unless the self-erected barrier is dug through, the receding tide, swelled by the fresh water coming down will break out of the lake at some weaker point, and find its way to the river by the path that offers least resistance.

A lake basin once strongly formed would be made stronger by each tide. As the moss gradually settled the barrier would become higher and the lake deeper. One would expect a heavy flow of fresh water to keep the barrier worn down, therefore the largest lakes should be where there is the least flow of fresh water. This is just what is found. Sunken Island, one of the largest lakes, has no stream of any size flowing into it. At the head of Morice's Mill Pond, Sackville, before the dam was put in, there was a small lake reaching from W. W. Fawcett's to the mouth of Beech Hill Stream. Mud extends all over the pond bottom and up the stream to the foot of Beech Hill. The lake is dammed off with marsh mud. The history is evident. The mud has shut off the lake as before described, and the rush of fresh water down Beech Hill Stream has kept the stream open below. When the subsidence of the marsh areas become almost *nil* the lands that had kept their drainage open in course of time became covered with salt grasses. The growth of these grasses had been largely checked by the salt water, while the marsh was settling. Now only the highest tides would cover the drained marsh, and the lakes would be practically freed from any incursions of salt water. Moss then sprang up around these fresh water lakes. Year after year this moss reached out and grew higher. Most of these moss plants are of the genus *Sphagnum*, and growing one upon another they kept above the level of the water, and grew out over it. This moss was always full of water and exposed such a breadth of surface to the air that the greater part of the water was carried off by evaporation. The moss itself, at least in the older lakes, formed an additional barrier against the tide. In digging the Floating Canal many trees of small size were found buried in the moss. When once started the moss grows over a lake very rapidly. Many of the lakes on the Tantramar have become markedly smaller in the memory of men now living.

Sunken Island is a great lake overgrown with moss, and in this moss are heaths, etc., and stunted trees. Many of these trees are from 15 to 25 feet high, 10 inches in diameter, and show 60 or more

rings of growth. Few of the lake bogs have such large trees on them, and few have become so filled with moss. There is every evidence that this lake was one of the earliest to be dammed off. In the first place it is several miles nearer the mouth of the river than the other lakes, and its position between the Aulac and Tantramar would make it liable to damming from both sides. The small amount of fresh water running out of it would make this easily possible. One or two small open lakes of less than an acre in extent alone remain of the original lake which probably covered nearly one thousand acres. There are about seven feet of water in these lakes, and the depth is about as great close to the shore as farther out. The moss projects over the water in such a manner as to make it dangerous to approach the margin. When examined last by the writer there were several large pieces of detached moss floating in the centre. The moss is now intergrown with heaths, bullrushes, coarse grass, cranberry vines, pitcher plants, etc., so that the "hackmatacks" (larches) find a fair amount of soil in the rotting vegetable matter.

A good deal of money has been spent in Sunken Island with little or no results. The moss is so high that a great deal of salt water will be needed to kill it, and a long time will pass before it will be properly settled. In fact since the aboideaus were blown out and the tide allowed to flow in unhindered on the "Big Marsh," the water has not risen high enough to enter this island at all.

The digging of a canal into the Jolicure Lakes has been agitated for some time. The owners of the Sunken Island body hope the route selected may be through the island. Should the canal take that course the bog could be made into marsh, and probably pay a dividend to the investors.

North-east of Cole's Island the Tantramar curves out, then doubles back on itself, leaving a point of land joined to the mainland by a narrow neck sixty feet wide. High tides swept over this and rendered the point unfit for cultivation. The water going up the river kept its old bed, but no sooner would it get around to the upper side of the neck than it would rush back over the neck to return again by the way of the main river. This gives one an idea of the rapidity with which the water rises as it runs up the river. This neck was cut off in 1893 by two of Sackville's enterprising farmers, and in 1894 there were twenty feet of mud deposited in the old channel. Several acres of marsh will be made from the reclaimed point and the old river bed.

If a canal were cut through the Ram-pasture neck, a similar curve further down, a much larger piece of marsh would be given to the country. Unfortunately the wharves are situated on the curve, and such a change would necessitate their being moved to another part of the river. So great is the rush of water back over this neck when the tide is flowing in, that several hundreds of dollars have been spent by the government to prevent the neck from wearing out of itself.

The work that has been done in building up the marsh soil is but small in comparison with what can be done. At the head of the Missiguash and La Planche rivers the lake and bog areas are extensive. With proper handling, thousands of acres of marsh can be made. The work is being agitated, but the large immediate outlay required, and the prospect of slow returns, deter capitalists from hastening into what at first sight appears to be a fine investment.

Since writing the above paragraph a company has been formed for the purpose of draining the areas at the sources of these rivers. They have had a surveyor on the ground for the past year, and at present have dug two miles in a canal intended to tap all the lakes on the marsh. At present a steam dredge is working about five miles above the mouth of the Missiguash. They began to dig three miles from the mouth, and have made a canal fifteen feet deep by thirty wide, decreasing in depth at the rate of two feet per mile as it approaches the lakes. At Round Lake, which is six miles above the mouth of the canal it should be six feet deep. A number of smaller lakes will be drained before Goose Lake at the head of the marsh is reached. In all there are about ten thousand acres at the head of the two rivers. Near the mouths of these rivers there are already valuable marsh areas. Surveys made in connection with the projected ship canal and marine road, have given abundant material in regard to levels, etc., on this bog. From a study of the levels used by the Missiguash Marsh Company the following data have been obtained: Taking a line one hundred feet below the Saxby tide as a basis, the ground surface at the mouth of the Missiguash is ninety-two feet above datum. The bog surface ten miles up the marsh at Round Lake is ninety-five feet above datum. The average spring tide is ninety-six feet above, while the Saxby tide was one hundred feet above. As the bottom of the lakes is scarcely ninety feet above datum, there will be a good fall from a high tide in the river into the lakes; these should therefore fill with mud and come quickly into grass. The bog begins about six miles from the mouth of the river, and the whole area above that is floating

bog and lake. That the bog is actually floating on mud and water, there can be no doubt. There are from two to three feet of moss and below that as much more rotted moss and water, forming a semi-fluid substance. It does not seem possible that the lakes are held in by this moss; on the other hand the water in places run under the moss, and acts in some ways as a lake with a thin layer of ice on its surface.

E. P. Goodwin, C. E., who has been engineer for the company for the last year, thinks that this moss can be cut in large squares and floated out the canal when the barrier of mud is cut away. It would seem as if the canal being dug is too small when the very slight fall is considered, and the area of the submerged lands.

Borings are to be made this winter all over the bog by Mr. Goodwin, and in the spring new light may be thrown on the history of these regions. So far the canal has not cut through to the bottom of the marsh mud in one instance, nor has it come in contact with one stick or other sign of vegetable remains.

The Marsh Soil.—The sediment floated up by the water is formed from the wearing away of carboniferous sandstone and shales. As the water is comparatively clear at the entrance to Cumberland Basin, the rocks which yield the deposit must be situated above this. At South Joggins nearly two feet of rock are worn away each year, and no doubt the wash is carried up the bay to make marsh soil.

The mud is of an exceedingly fine texture. While very little grit can be detected by the fingers or teeth, it nevertheless contains a large amount of sand as seen in an analysis. Tools that are used in working it soon become blunted. A heavy bolt was worn through on the steam dredge in a few weeks from friction with the soil in shovelling. When wet it seems almost soluble, and is very sticky. After being quickly dried by the sun a harrow has little effect on marsh mud, it being almost as hard as brick. In many cases seed is thrown on the plowed land and the rain causing the soil to run buries it with little or no harrowing.

The marsh soil is naturally of a red color, and this red soil constitutes the valuable marsh. Hay has been cut from this for 100 years and more without materially impairing its fruitfulness. Large quantities of red mud are annually carted on the highlands, and, as a fertilizer, for many soils it is considered equal to barnyard manure. No analysis that has yet been made will explain its marvellous fertility. Sir Wm. Dawson (*Acad. Geol.* p. 23) thinks it may in a part be due to the presence of fish bones and vegetable remains which do not appear in

an analysis. This seems very doubtful. May one cause not be the extreme fineness of the soil which enables the plant to get its food readily? One reason that so much land is not fertile is that the necessary ingredients are not in a state available for plant food. This soil is in such a fine state of division that it must present a great deal of surface to any dissolving agent. That it is rich there is no doubt, as land that has been cutting heavy crops of hay for nearly two centuries will give a rank growth of timothy when turned up by the plow, and that without one bit of fertilizer during all this time.

Fertility is only insured by a thorough system of drainage. If allowed to lie in the water the red soil changes to blue, and the growth of moss and coarse grasses gives the soil a corky texture. The blue mud covers all the low marshes, but usually has red mud under it at no great depth. This quality of marsh is much less valuable than the red, as it will produce coarse grasses and sedges only. When plowed and drained a good crop of oats can be obtained, but even the native grasses refuse to grow the following year.

This change from red to blue is an interesting one. The red mud derives its color from peroxide of iron. In the blue mud the iron is in a state of a sulphuret. The change is brought about by the decay of vegetable matter. The salt water contains salts of lime and magnesia. The vegetable matter excluded from the air unites with these two sulphates of lime and magnesia, liberating the sulphur as hydric sulphide and retaining the oxygen. The sulphide can be detected on any low marsh by means of its unpleasant odor. This gas now unites with the oxide of iron in the mud, producing iron sulphide which gives the marsh its blue or gray color. When the water is drained off, the iron of sulphide unites with the oxygen of the air, forming iron sulphate, a substance poisonous to most crops. This shows why blue mud when drained refuses to grow even the native grasses. When heated the iron sulphate is changed to a brown powder, an oxide of iron similar to the ore, limonite. It is this oxide hydrated that is seen in the bottom and sides of so many marsh ditches. (Acad. Geol.)

Analyses of several Bay of Fundy marsh soils made at the Central Experimental Farm, are given below for the sake of comparison :—

Unclaimed Marsh near Amherst, 1897—

Moisture.....	3.78
Organic and Volatile.....	5.86
Coarse Sand.....	16.60
Fine Sand and Clay.....	58.73
Nitrogen.....	.137

Sackville Marsh, 1897—

Potash.....	.16
Phosphoric Acid.....	.16
Nitrogen.....	.131
Lime.....	.13
Loss on Ignition.....	5.83

Unclaimed Marsh at Quaco, 1897—

Air dried sample.

Moisture.....	7.66
Organic and Volatile.....	7.61
Insoluble Mineral Matter, Sand and Clay.....	71.96
Mineral Matter soluble in acid.....	12.77
Lime.....	.42
Nitrogen.....	.24
Common Salt.....	1.4

Mud from Five Islands, N. S.—

Nitrogen.....	.079
Organic and Volatile.....	5.23
Sand and Clay.....	76.73
Mineral Matter soluble in acid.....	15.9
Water.....	2.85

Gaspereau River, N. S.

Nitrogen.....	.084
Water.....	11.11
Clay and Sand.....	74.28
Organic Matter.....	3.35
Oxide of Iron and Al.....	8.08
Lime.....	.54
Potash.....	.40
Phosphoric Acid.....	.12



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